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AID Report P-63-59

10 May 1963

HYDROCARBON-OXIDIZING AND SULFATE-REDUCING BACTERIA

Compilation of Abstracts

404 908

AID Work Assignment No. 28

(Report No. 23 in this series)

Aerospace Information Division
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The four abstracts comprising this report have been prepared in response to AID Work Assignment No. 28 and represent information indirectly relevant to the production and handling of Soviet jet fuels.

1) Telegina, Z. P., M. I. Subbota, and Ye. A. Nikitina. Patterns of the occurrence of hydrocarbon-oxidizing bacteria in the waters of the profile strata of the Izbaskent oil and gas field. Mikrobiologiya, v. 32, no. 1, 1963, 33-38. QR1.M65, v. 32

The article is aimed at assessing the effectiveness of hydrocarbon-oxidizing bacteria as indicators of oil and gas deposits. Neogene, Paleogene, Neogene-Paleogene, and Upper Cretaceous strata of the area, which is located on the northeastern edge of the Fergana depression, were studied. For the most part water samples were taken from gushers, although some were taken from springs.

Methane-, ethane-, propane-, and butane-oxidizing bacteria were found down as far as 2680 m. The abundance of these bacteria in the waters of Bactrian strata in the vicinity of the oil deposit is explained by the migration of hydrocarbons. Hydrocarbon-oxidizing bacteria are absent or widely scattered in more distant Bactrian strata.

Hydrocarbon-ozidizing bacteria occur less frequently in Paleogene strata than in Bactrian strata. Methane-, and propane-oxidizing species predominate in the Paleogene, but seldom occur beyond the oil-deposit contour. All four species of bacteria were found in one of two samples taken from Cretaceous strata; the second sample contained none.

The work was completed at the All-Union Scientific Research Institute of Nuclear Geophysics and Geochemistry and submitted for publication 21 February 1962.

2) Slavnina, G. P. Thermally stable bacteria which oxidize gaseous and liquid hydrocarbons. Mikrobiologiya, v. 32, no. 1, 1963, 121-126. QR1.M65, v. 32

The purpose of the work is the study of the distribution of petroleum-indicating bacteria by depth in oil wells of Western Bashkiriya and Northern Ciscaucasia. The subsurface waters were investigated for the presence of hydrocarbon-oxidizing bacteria. Bacteria which oxidize

hydrocarbons of the paraffin series from C_1 to C_{10} were detected. The findings for the Ciscaucasian wells are given in tables. In all the wells, hydrocarbon-oxidizing bacteria were found at depths from 640 to 2320 m. Methane- and decane-oxidizing species were predominant. Heptane-oxidizing bacteria were seldom found. An opinion is expressed that the methane oxidizers were brought from the surface and are not characteristic of deep thermal subsurface waters.

The following species were separated and identified in the laboratory: in methane atmosphere, Methanomonas methanica; in propane, Mycobact. rubrum v. propanicum, Mycobact. equi, and Mycobact. sp. (the last species is similar to Mycobact. luteum, except that it coagulates milk and liquefies gelatin); and in butane, Mycobact. luteum, and Mycobact. flavum, Ps. scissa. The most widespread liquid hydrocarbon-oxidizing species is Bact. aliphaticum liquefaciens, which grows very effectively in the heptane atmosphere. The octane-oxidizing species is very similar to Ps. fluorescens and the decane-oxidizing to Ps. putida.

The high thermal stability of native hydrocarbon-oxidizing bacteria is noted. Thermophilic bacteria separated from thermal waters are more active as oxidizers of gaseous hydrocarbons than mesophilic bacteria. The study confirmed the existence of native microflora in deep subsurface waters.

The work was completed at the All-Union Scientific Research Institute of Nuclear Geophysics and Geochemistry and submitted for publication 20 November 1961.

3) Smirnova, Z. S. Results of a study of the air of petroliferous areas for the presence of hydrocarbon-oxidizing bacteria. Mikrobiologiya, v. 32, no. 1, 1963, 128-130. QR1.M65, v. 32

Air samples were taken from several Western Bashkiriya petroliferous areas with varying degrees of probable contamination. No gaseous hydrocarbons and no hydrocarbon-oxidizing bacteria were discovered in the samples except in the Subkhankulovo district, where a crude-oil pipeline had burst a year before the samples were taken. Here propane-, butane-, and pentane-oxidizing bacteria were found in the air.

The work was completed at the All-Union Scientific Research Petroleum Institute of Geological Exploration and submitted for publication 21 October 1961.

4) Pomortseva, N. V., and V. M. Senyukov. Effect of antibiotics on sulfate-reducing bacteria. Mikrobiologiya, v. 32, no. 1, 1963, 131-135. QR1.M65

Sulfate-reducing bacteria produce hydrogen sulfide, which is highly undesirable in oil fields, since it is poisonous and malodorous and causes corrosion of equipment. The purpose of this article is to study the possibilities of inhibiting the growth of these bacteria by the use of antibiotics. The experiments were conducted *in vitro* with a culture obtained from the subsurface waters of the Yelshano-Kurdyum oilfield. A Van Delden medium was used for the propagation of the bacteria. The formation of the black sediment of iron sulfide served as the indicator of H_2S evolution.

The following 16 antibiotics in concentrations of 1,2,5,10, 20, and 50 γ were tested: penicillin (sodium salt), phenoxymethylpenicillin, tetracycline, hydroxytetracycline, chlorotetracycline, streptomycin sulfate, dihydrostreptomycin, colimycin, mycerin, erythromycin, polymyxin, albomycin, nystatin, and phytobacteriomycin (sulfate or hydrochloride). Aqueous solutions were used except for nystatin, which is soluble in formamide, and phenoxymethylpenicillin, which is soluble in alcohol. The experiments were conducted at 22 to 25°C.

The results indicated that erythromycin (active in concentrations from 1 γ through the range tested) and streptomycin (active from 5 γ) were the most effective. However, use of the antibiotics of the streptomycin class is impractical because of the instability of these antibiotics in solution. One antibiotic from this class, phytobacteriomycin, remains a good prospect, however, because of its stability in aqueous solutions with pH below 8, the pH of most strata waters. It is active in concentrations of 20 γ as sulfate and 50 γ as hydrochloride. The presence of petroleum does not affect the activity of this antibiotic.

The work was completed at the All-Union Scientific Research Institute of Natural Gas and submitted for publication 6 February 1962.

COMMENT:

It is evident from these four abstracts that the problem of the occurrence and identification of hydrocarbon-oxidizing and sulfate-reducing bacteria is a continued topic of discussion in the USSR. The purpose of the works reported is clearly the utilization of the data obtained for oil and gas exploration. The problem of corrosion of oilfield equipment is mentioned in the last article on the inhibition of sulfate-reducing bacteria by antibiotics. It would be quite logical to extend the findings to corrosion prevention in fuel tanks, but as was stated in previous reports, such work has not been reported in the Soviet periodicals devoted to crude and petroleum products.